CDV system description

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CD VIDEO

Circuit Description

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1 Compact Disc Video

CDV is the CD–audio extension in the field of video.
CDV is playback system that combines the purity of CD sound with video. On the CDV disc one track comprises both the CD audio data and the video data. Within the successful CD system the following standards have been laid down:

CD–audio
CD–ROM
CD–Write Once
CD–video
CD–Interactive

The CDV standard falls within the standard of the CD audio system, both have been laid down in the "Red Book" Standardization of the medium and of the playback equipment, they form the basis of a consumer–friendly home entertainment system. The standard of the medium (the disc) is based on the CD–Audio standard. In this CD–Audio standard the medium has been used optimally. To obtain additional space for the video data the scanning speed is raised from 1.25 m/s to 10.5 m/s. In this manner more data will be available per unit of time. However, this implies that the overall play time is reduced. Also see block I. Sets equipped with the CDV system bear the CDV logo.
The sets can thus immediately be identified by consumers and repairers.

Fig. 1 The CDV logo

BLOCK I The frequency spectrum on the CD disc

The highest frequency to be mastered on the disc is determined by the smallest pit–mesa–pit to be identified and the reading speed of the scanning device. With a reading speed of 10.5 m/s the highest frequency to be retrieved from the disc is about 11 MHz. This frequency is determined by the numeric aperture of the lens, the wavelength of the laser and the reading speed. Usually this data can be found in the commercial specification of the CDV players and is related according to formula $f = v2NA/\lambda$

f = maximum frequency of the disc
λ = wavelength of the laser
v = reading speed
NA= Numeric Aperture

In the CD audio system the bit rate mastered on the disc is 4.32 Mbit/s. In the case of eight to fourteen modulation the minimum number of zeroes between two ones is two. See Figure 2.

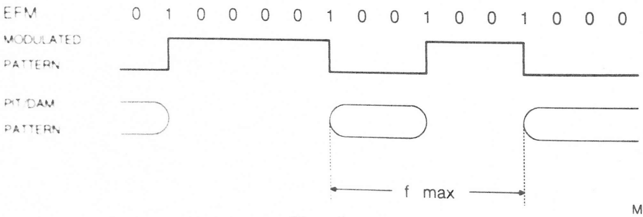

Fig. 2

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The highest frequency of the fundamental wave to be mastered on the disc will be 4.32 / 6 = 720 kHz. In reality the frequency is at least 2x as high to guarantee sufficient slope. The highest frequency in the spectrum that is mastered on the disc is about 1.8 MHz for the digital audio data. Figure 3 shows the frequency spectrum of a CD disc.

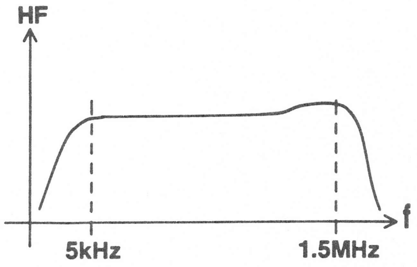

Fig. 3 The frequency spectrum on a CD disc

2 The discs within the CD system

In addition to the CD audio disc some specific CDV disc have been defined in the CDV standard. The characteristic of these discs for the consumer is the golden colour. This indicates that the disc contains video data. The only function of this colour is to distinguish it from the silver audio discs. The reflective power of the CDV discs equals that of the silver audio discs. The scanning laser does not distinguish between the silver and the golden reflection. The table below gives an enumeration of the CD(V) discs that can be played on a CDV combi player. On a CDV clip player only 12 and 8 cm discs can be played.

Disc type	diameter	play time	data
CD audio	8 cm= 3"	20 min.	dig. audio
CD audio	12 cm= 5"	60 min.	dig. audio
CDV single	12 cm= 5"	20 min.	dig. audio and video with dig. audio
CDV EP	20 cm= 8"	20 min.	video with dig. audio
CDV LP	30 cm=12"	60 min.	video with dig. audio

Figure 4 shows the discs from left to right.

Note: CDV players equipped with FM audio demodulators can also play with the LV standard which preceded CDV.

The CDV single has a diameter of 12 cm, just like an audio disc but it is golden. Up to a diameter of about 8 cm twenty minutes of ordinary Digital Audio (DA) is mastered on the disc. This can be compared with the quantity of data on an 8 cm disc. The remaining part between the diameter of 8 cm and the edge of the disc contains video data with DA. This part of the disc must be played with the high video speed.

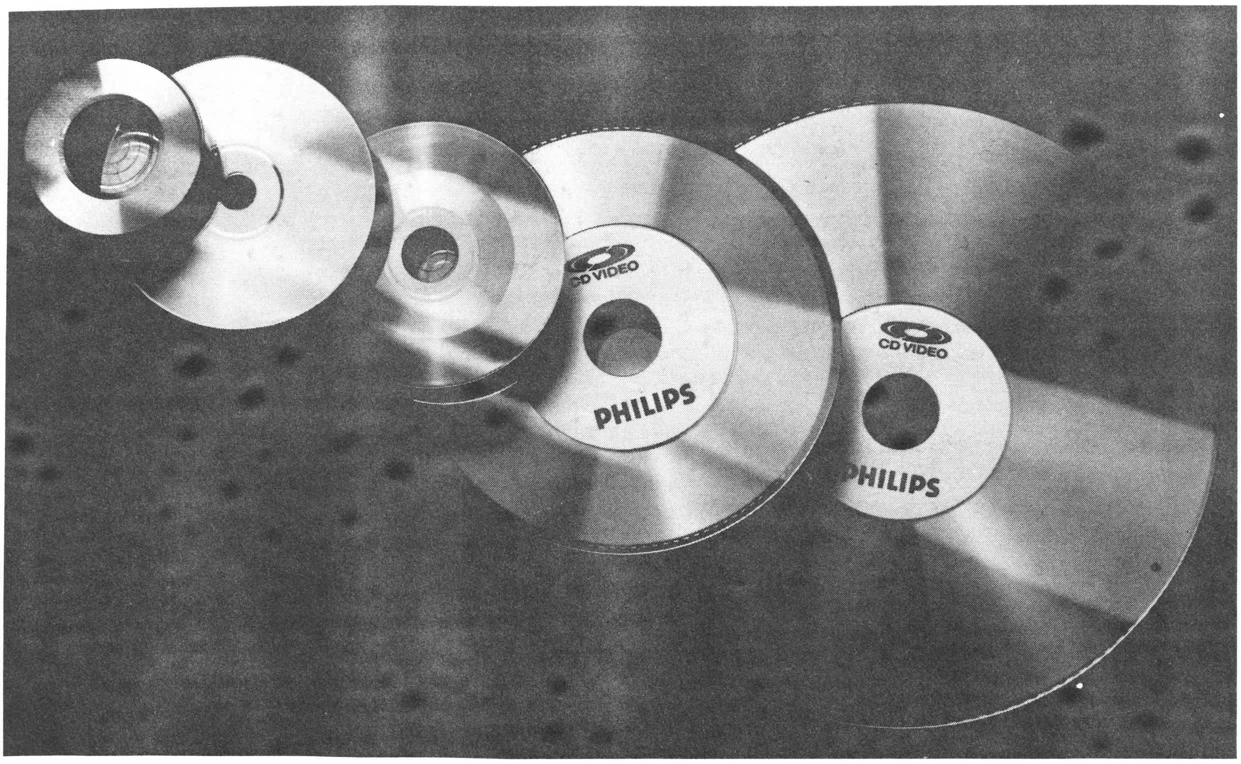

Fig. 4

BLOCK II Division of the disc

To get a good impression of the initial and end diameters of the information rings on the disc a survey has been made. In the survey half of the vertical disc cross-section has been drawn. The 30 cm disc is shown abridged in the drawing. Each transition is always accompanied by the corresponding radius.

COMPACT DISC DIMENSIONS

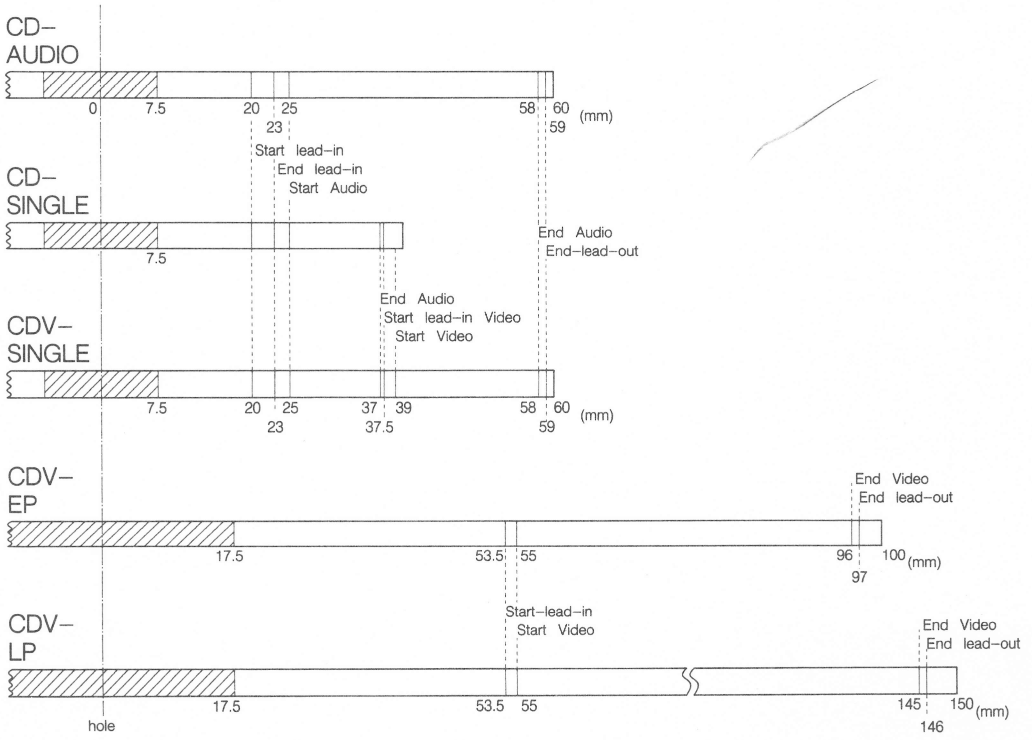

Fig. 5

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In general the identification of the type of disc by a CDV player, which can also play the large types of discs, proceeds as follows:

- The first check is whether the disc is larger than 12 cm. If this is the case, the disc is started in the high speed, the video lead–in is searched and the disc is played in the video mode. This is only possible when the video system (PAL, NTSC) of player and disc are consistent.
- In the case of a small disc (CDV single, CD audio 8 cm and 12 cm) the audio lead–in is searched. In this lead–in you will find the Table of Contents (TOC) of the disc. The TOC also mentions whether the disc contains video data or not. If it is a CDV single, first the video part is played and then the audio part of the disc. The latter is a software matter and may vary from player to player. If the video system is not consistent with the player, the video track cannot be played.
- If the TOC mentions that it concerns an audio disc, the audio part is played immediately.
- Special tracks as present on CD–ROM discs or CDI discs which do not meet the CDV or CD Audio format, are played but the data is only available on the digital output.

3 Features in CDV

In the modern HiFi equipment ease of operation is coupled with a high sound quality. In the past a high sound quality used to be accompanied by a meagre featuring. To enable the search of music tracks these tracks should be assigned a label. In modern systems this is done via the system supporting data. For CD Audio the audio data is interleaved with this system supporting data. For CD audio this is called subcode. The subcode contains information on start and stop time of a music track relative to the beginning of the disc as well as the serial number of the music track. With active–play discs, where it is possible to show still pictures without picture memory, use is made of a video–data related code, the Manchester code. This code is available in a few picture lines during the raster blanking. In the CD audio music tracks and CDV films, which have been mastered on disc with the maximum density, other music tracks can be searched with the Track number and Index system known from CD. On CDV discs with active play the films can be searched with Chapter numbers and the separate pictures with frame number. See block III for more information on active play. Other features such as FTS and RANDOM are pure control manipulations which are in principle also possible with other systems if only they are provided with system supporting data. DAT and CD are such systems. A list with features which have been implemented in the CDV 45 is given in figure 6.

Function	Operation	Options
Start	The player automatically turns on, and if a disc is pre-loaded starts to play it, as soon as power is applied.	On/Off
FTS	If a disc with an FTS programme is loaded, the programme is automatically played.	On/Off
Random	RANDOM mode is selected whenever a disc or FTS programme is played.	On/Off
Repeat	REPEAT mode is selected whenever a disc or FTS programme is played.	On/Off
Memo stop	Play recommences from where it has previously been stopped.	On/Off
Display	The On-Screen display can automatically show a particular time when play recommences from 'Stop'.	Off, Elapsed track, Remaining track, Remaining Total, Total.
Mode	Selects playback mode when a CDV Single is played.	Total, Audio, Video.
Speed	Pre-defines a preferred play speed for slow or fast motion.	3 sec, 1 sec, 1/16, 1/8, 1/4, 1/2, 1/1, 2/1, 4/1, 8/1.
Edit	Pre-defines the compact-cassette tape size for the 'Edit' function.	C60, C90, C120.
Colour	Pre-defines the background screen colour.	Normal, Single.

Fig. 6 List with features of the CDV 495

BLOCK III Active play and CAV

Active play is a term which describes that the user can use his CDV player actively. This term implies that he can stop pictures, while preserving the quality and without interference. Furthermore, slow motion and fast play are possible. In this mode it is also possible to store 54.000 loose pictures on one side of a 30 cm CDV disc. To play loose pictures it is necessary to ensure that immediately after playback of a picture the same picture can be played. This is possible on CAV (Constant Angular Velocity) discs. After one revolution the system jumps one track back. The result is the still video picture. This jumping back is only possible when there is exactly one picture (2 frames) per revolution.
To playback 25 picture per second the disc should constantly make 1500 revolutions per minutes (CAV). If the system changes track during the vertical blanking (time between two pictures), the pictures can be played back in a different time sequence. Reverse motion and fast forward are made in this manner. See figure 7.

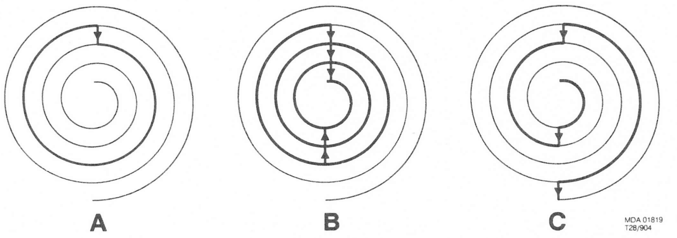


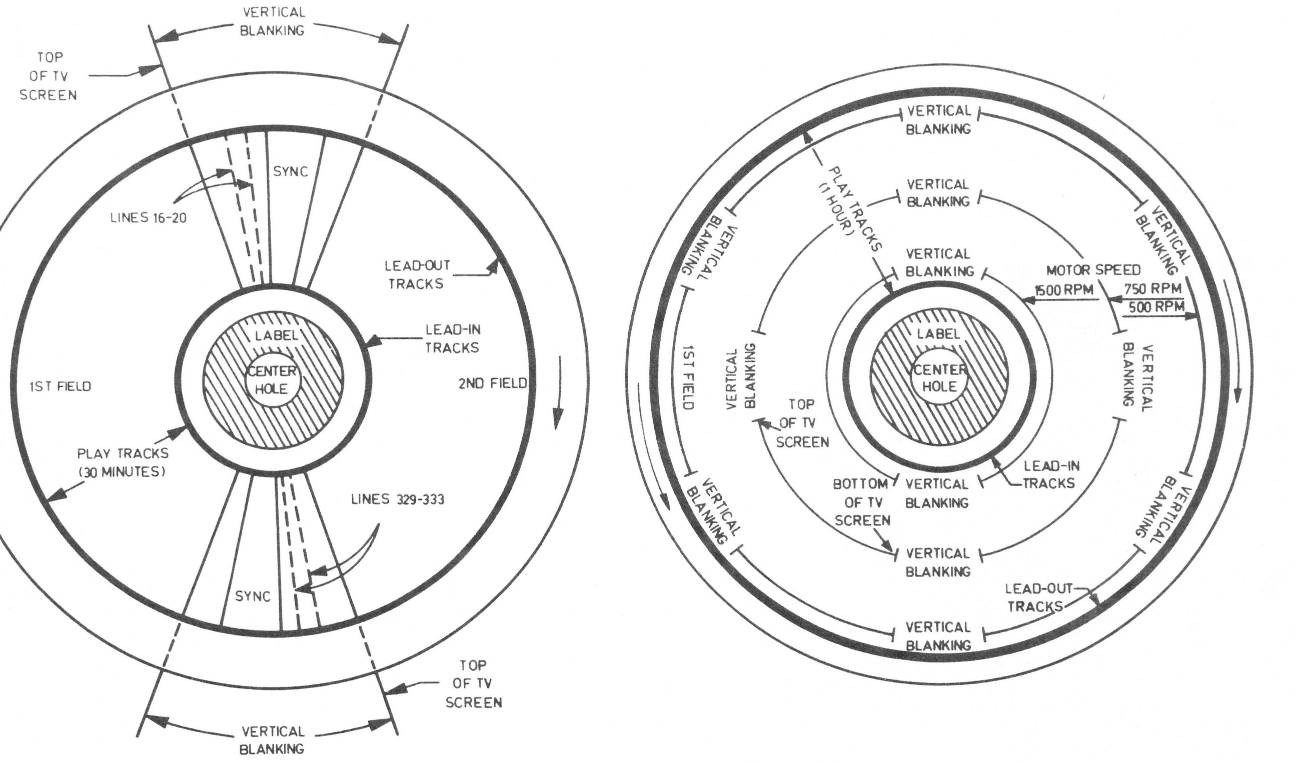
Fig. 7

A. One reverse switch per revolution produces a perfectly stable still frame.

B. One reverse switch per half revolution produces reverse motion at normal playback speed.

C. One forward switch per half revolution produces three times normal speed forward.

With a CLV (Constant Linear Velocity) disc the pictures are registered on the disc in the most economic manner. On the tracks at the outside of the disc more than one picture per revolution is mastered on these discs. The reading speed (laser relative to disc) is constant, viz. 10.5 m/s. As a result the play time of one hour per side is reached for the 30 cm disc. To get 6 minutes of video playback with the CDV single, here too the CLV method has been used. A drawback is the brief picture disturbance which occurs during track jumping. Sound reproduction during active play is not possible.
Figure 8 shows how the pictures are recorded on the disc for the different registration methods. For the CAV disc the circle frequency of 25 Hz is sometimes mentioned instead of 1500 revolutions per second.



CAV

CLV

Fig. 8 *Comparison between CAV discs (constant motor speed, variable field track length) and CLV discs (variable motor speed, constant field track length).*

4 Build-up of a CDV player

A CDV player consists of a number of basic parts which perform the functions to play picture with DA. It must also be possible to play the audio tracks in the audio mode. Figure 9 shows the major system parts.

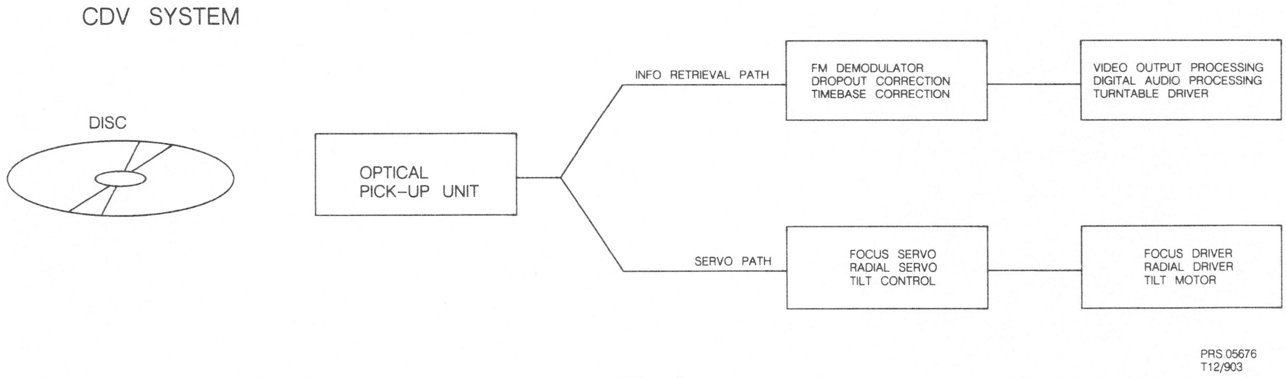


Fig. 9

The CDV disc is standardized as well as the minimum requirements for the Info retrieval part and the Tracking servo. The set up of the system depends on the selected system of the Optical pick-up unit. There are optical pick-up units which work according to the single-beam tracking principle and there are units which work with three-beam tracking. Each type needs its own specific servo circuits. The tracking servo sees to tracking of the laser and can be combined with any type of Info retrieval electronics. But the differences in speed between DA only and video with DA result in other requirements for the servo system. That is why there are provisions in the servo electronics to switch them over for tracking at high and low speeds.

5 Details for the scanning of CDV discs.

During scanning of CDV discs the beam must be focussed very accurately on the information carrying layer. Furthermore, the track must be followed very accurately. Also, in the case of sag of the disc, care must be taken that the angle between the disc and the light path always remains 90°, so that the light will be returned directly to the light path. This is the compensation of the umbrella effect. An incorrect angle will result in cross–talk between the tracks, see figure 10. A manner to avoid this error is to make use of an active tilt control.

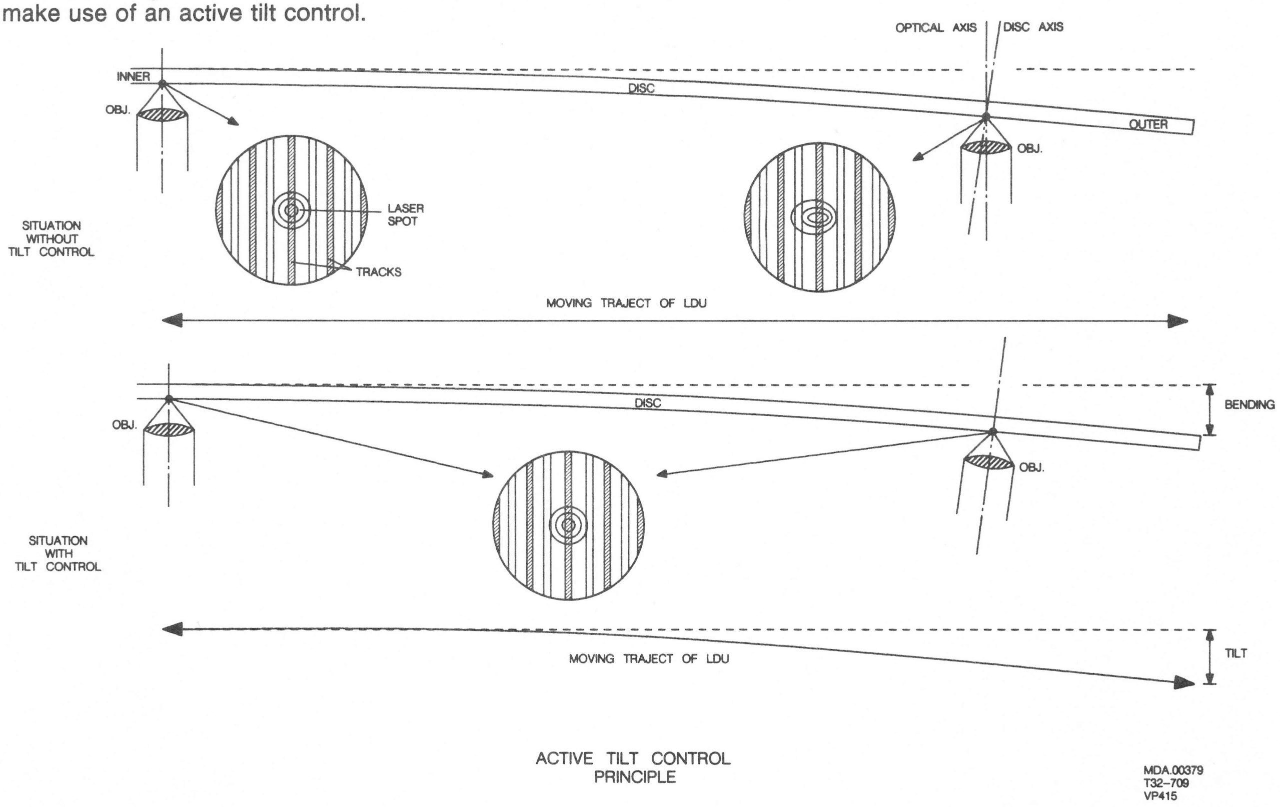


Fig. 10

During picture reproduction care must be taken that the picture lines arrive at the right moment and that the colour is correct. This is accomplished by ensuring that the data of the disc go into the colour demodulator at the right moment and with the right speed. Tangential errors disturb this timing. A tangential error may for instance develop when the hole is not quite in the centre of the disc.

The survey below mentions all errors that may develop. During playback of a disc these errors must be prevented as much as possible. The focus, radial and umbrella errors can only be compensated mechanically, i.e. via a servo system.

The tangential error can also be corrected electrically via a controllable delay. Contrary to earlier days the tangential error is always compensated electrically in modern videodisc players.

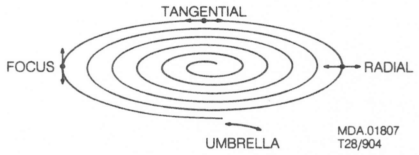


Fig. 11

Figure 11 is an illustration of the errors that may occur during the scanning of CDV discs.

6 The block diagram of the CDV 475

Figure 12 shows the general block diagram of the CDV 475. To the left-hand side the functional blocks which record signals have been drawn and to the right-hand side the functional blocks which form outputs. Some blocks such as the Pulsdet and the Carrefdet are specific for the CDV 475. In general these blocks just ensure that the player always knows where the slide is. The Carref detector finds the reference boss of the slide and the Pulse detector counts the number of spindle revolutions from this point onwards. The function of the X-det and the Tilt-det will be discussed in the section on the CDV mechanism. It is not possible to make one single block diagram for the different types of CDV players.

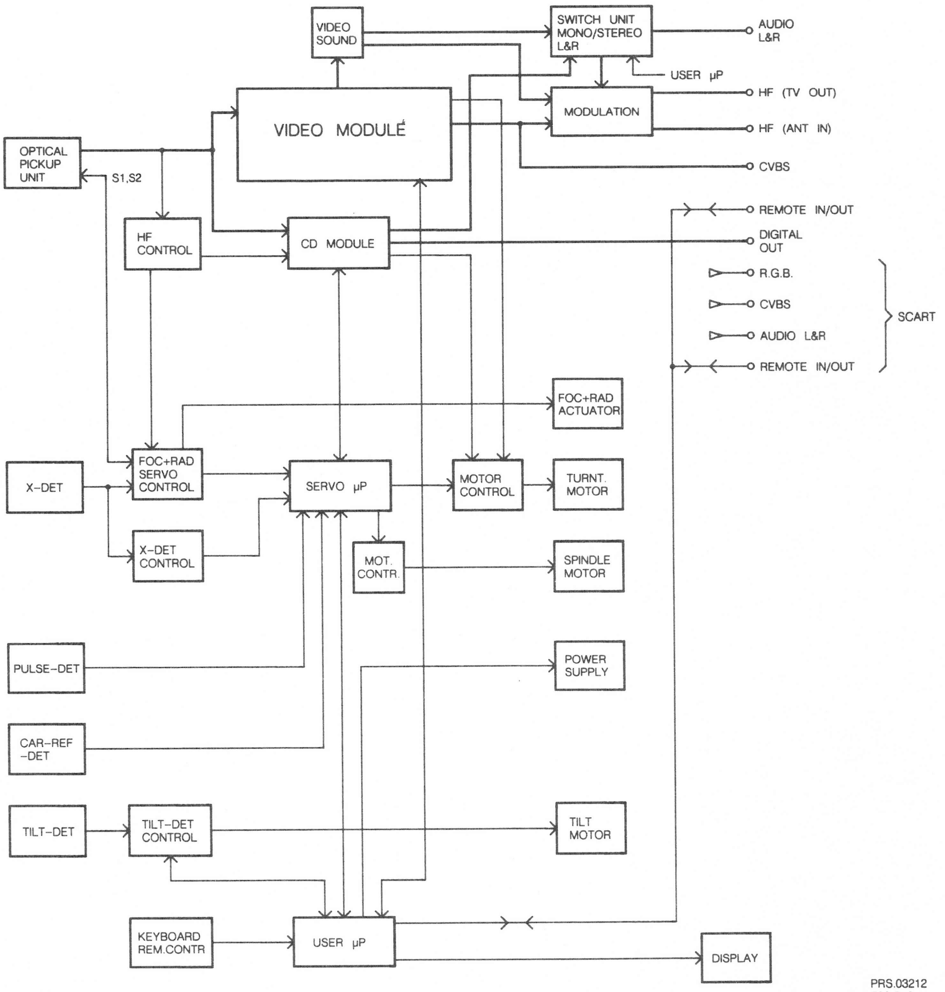


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Fig. 12

7 The CDV mechanism

A mechanical construction with optics to play CDV discs is called a compact disc video mechanism. With most CDV mechanisms we see a tracking system that consists of a slide which sees to the coarse tracking and a small arm or mobile lens for the fine tracking. Focussing is provided by letting the arm move up and down. The principle of the actuator is the same as for a loudspeaker. Usually the slide is driven via a spindle to see to the coarse tracking. In figure 13, the CDM 6, the spindle and the slide, here called optical pick-up unit, are clearly visible. In figure 18 the CDM 10 is drawn. With the CDM 10 the spindle is very short and the rack very long. This is made possible by positioning the spindle at an angle of 90° relative to the direction of movement of the slide. With the CDM 10 the spindle can no longer guide the slide. For this purpose a separate guiding has been used. The two-tooth rack runs parallel to the guiding. Together with a spring the double teeth take the play out of the spindle/rack transfer.

CDM-6 FRAME

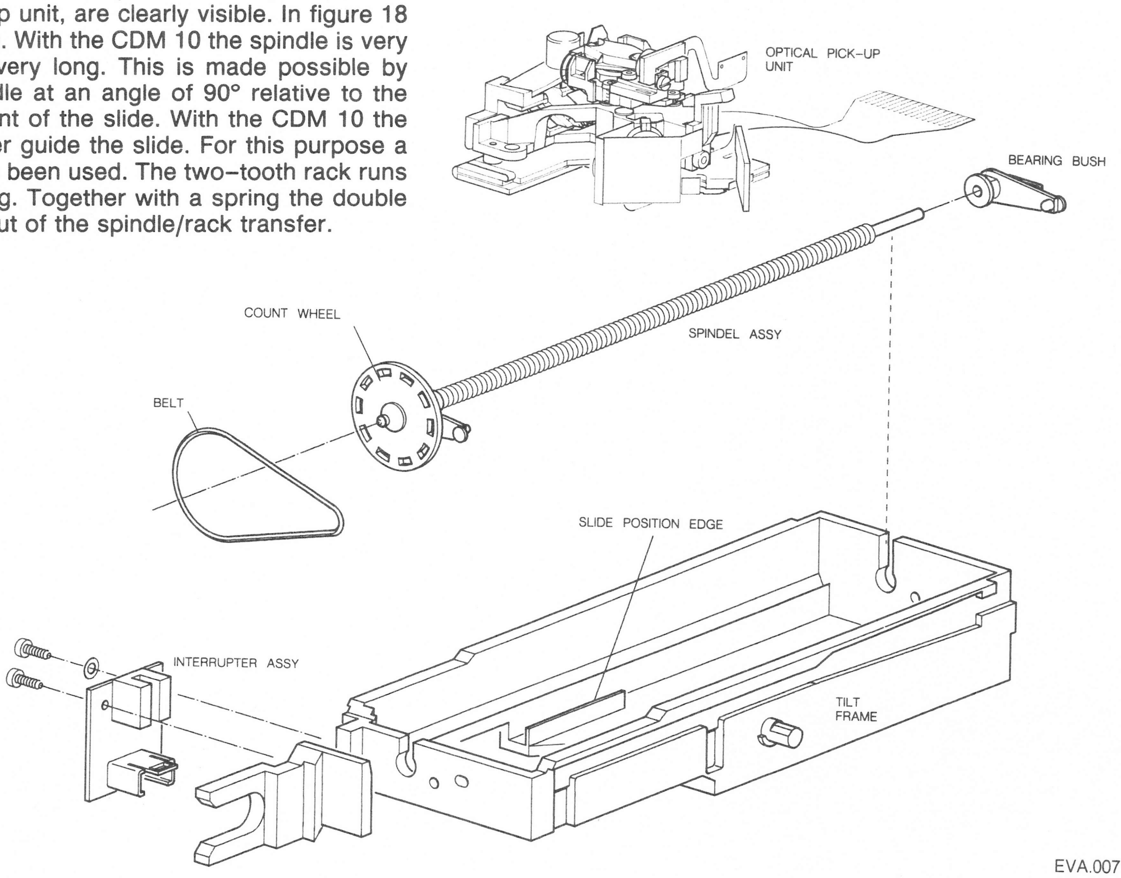

Fig. 13

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Fig. 14 once again shows the Optical Pick-up Unit

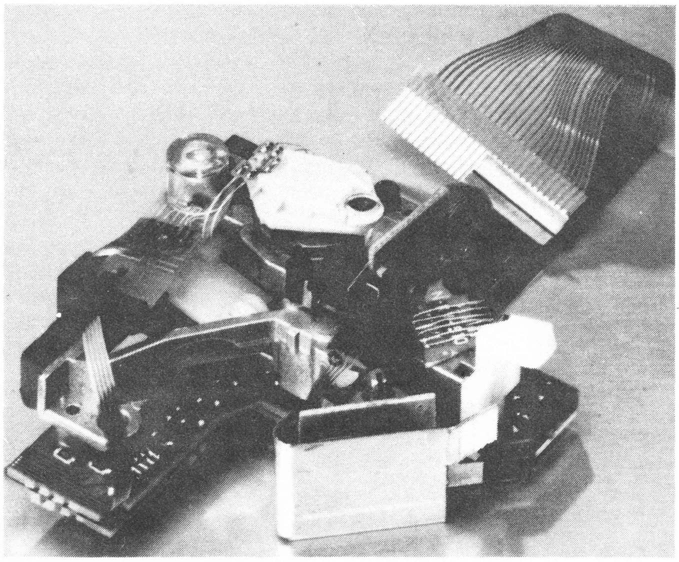


Fig. 14

The little tracking arm can best be seen in figure 15. Focus tracking is done by moving the entire arm in vertical direction. Since the arm has two possibilities of movement (two degrees of freedom) the arm is also called "2D actuator". The two bow springs, visible in figure 15, ensure that the 2D actuator assumes its mechanical rest position when no currents flow. The power supply of the 2 coils in the 2D actuator also runs via the bow springs.

The figure below shows the Optical Pick-up Unit of the CDM 6.

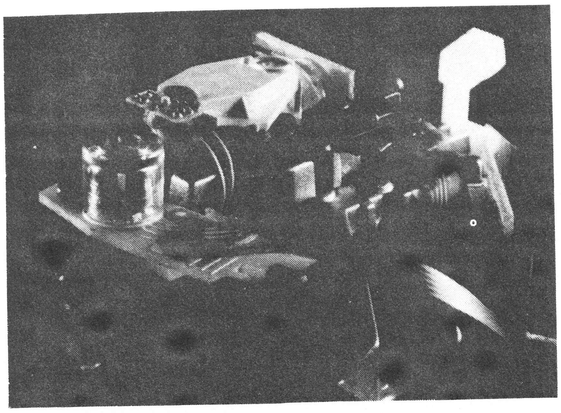


Fig. 15

With the CDM 6 tracking of the sag of the disc is done by tilting the frame in the radial direction (the frame is thus called the tilt frame). For CDV players which can only play discs up to 12 cm an umbrella compensation by means of a tilt frame is not necessary.

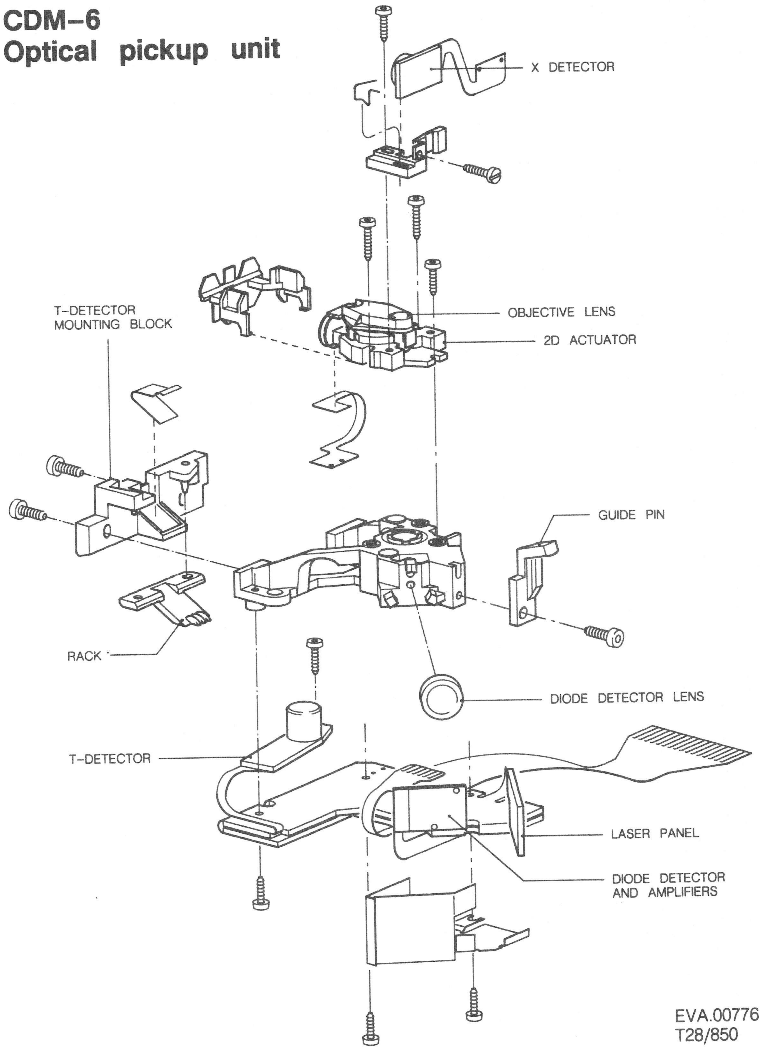


Fig. 16

Figure 17 shows the CDM 6 inclusive of the tray to load discs.

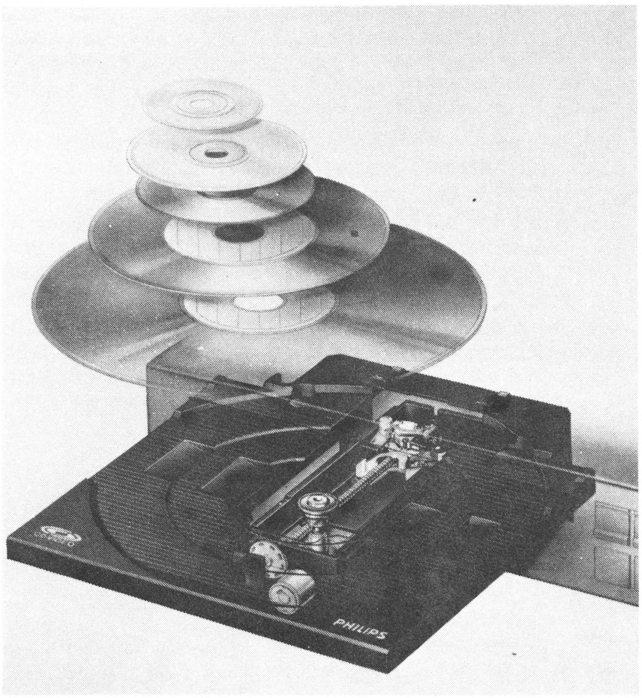


Fig. 17

The second generation of CDV players will be equipped with the CDM 10. An exploded view of the CDM 10 is given in figure 18.

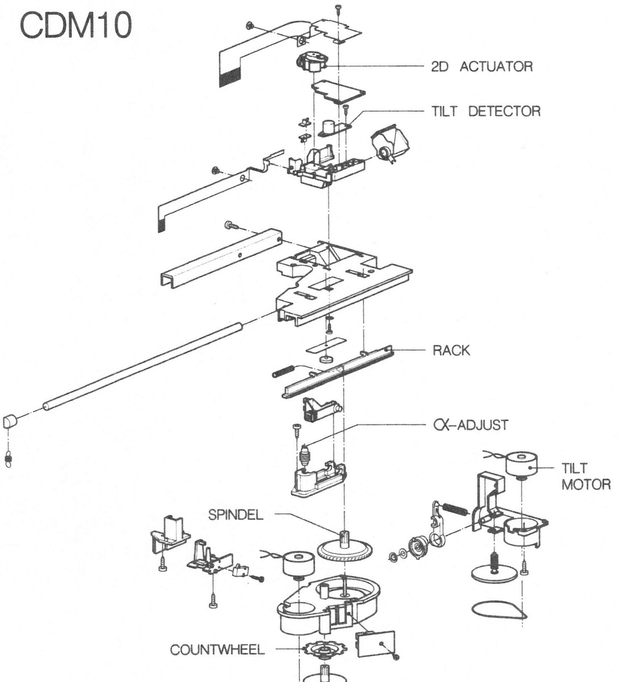


Fig. 18

The very flay optical pick-up unit of the CDM 10 is shown in figure 19. The transparent tube on the photograph is the tilt detector.

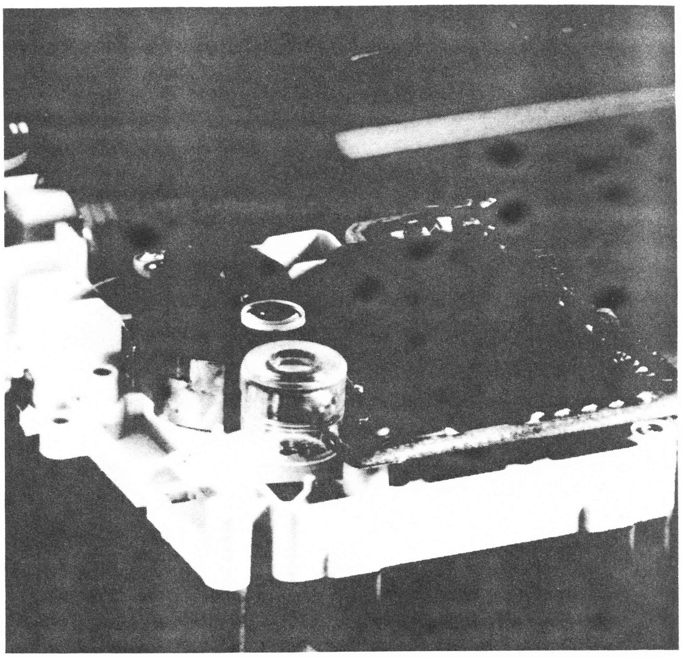


Fig. 19

8 Tracking Servo

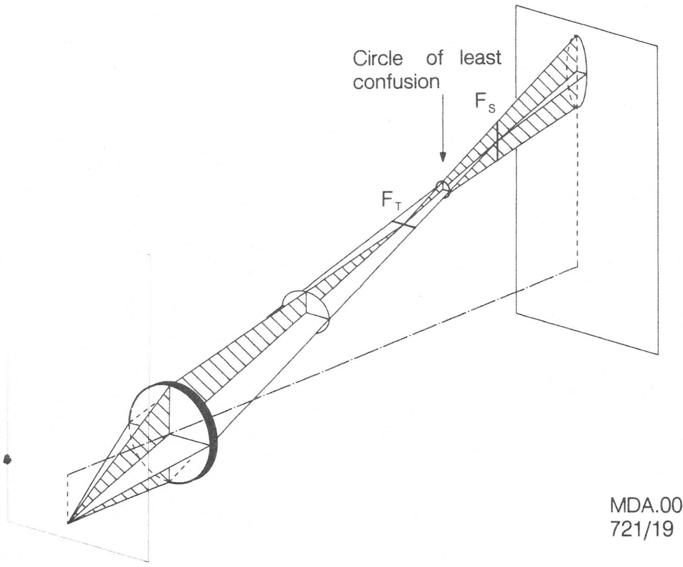
The tracking servo ensures by means of electronics that the scanning beam accurately follows the track on the disc. It is essential here that the extent of the error relative to ideal tracking is measured electronically. The extent of the error results in an error signal which is used to drive the mechanics in order to come to optimal tracking.

Tangential errors are not corrected by means of a servo system. The tangential control is purely electric. With a servo system the control always takes partially place in the mechanical domain. The drive specifications for the electro–mechanical converters may differ per type of mechanism. The method of error measurements may also differ. In any case the focus and the radial error must be measured in some way or another.

Servo systems with a large amplification are so designed that they will not oscillate, nevertheless a stepped excitation at the input might cause the system to oscillate or it might take very long before the system has reached its initial state after switching on. To prevent this from happening measures have been taken in both the focus and the radial servo.

- The Focus Servo
  With CDV mechanisms we usually find a focus error measurement which is based on the principle of the astigmatism.

  The CD mechanisms CDM 0 through CDM 5 have been provided with a focus system based on the Foucault principle. Figure 20 shows the principle of the astigmatism.



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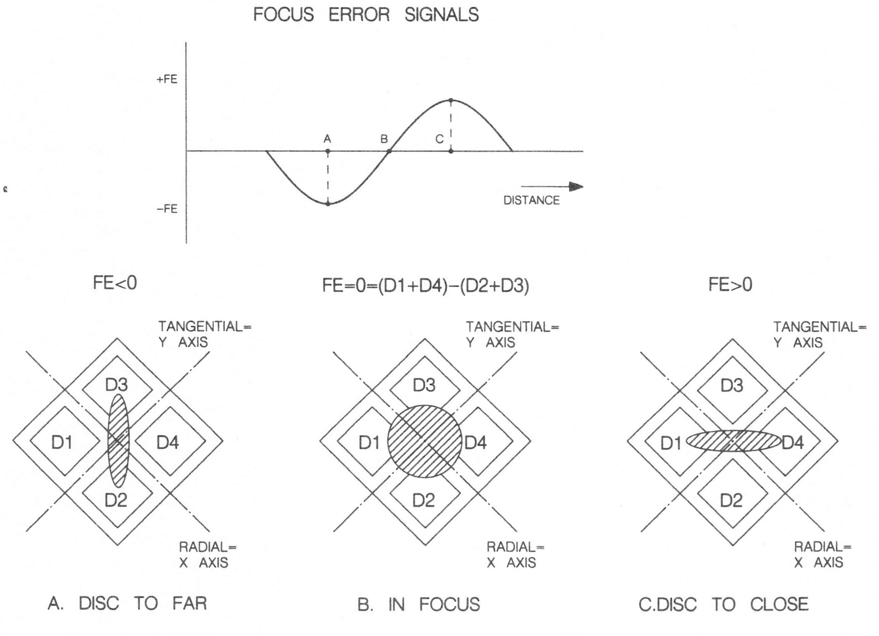
721/19

Fig. 20

For this purpose the light is sent through a cylinder lens and this results in an optical change of the beam around the focal point. In the focal point itself the beam no longer is very small but it is the smallest. This focal point is called the circle of least confusion. Immediately before and after the focal point the beam is an ellipse, on the understanding that the ellipses are rotated 90° relative to each other.
See figure 21.



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T28/850

Fig. 21

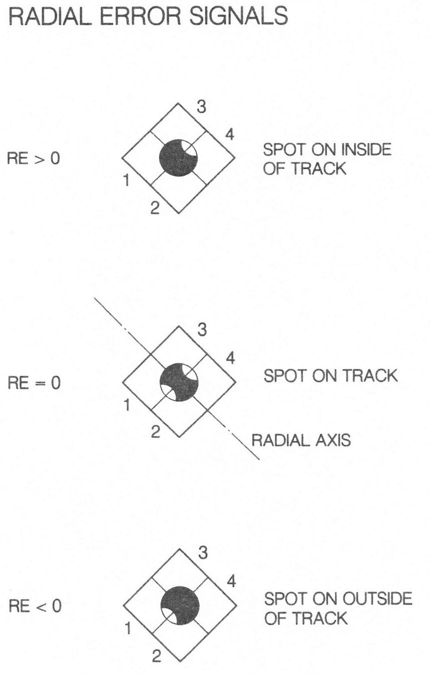
By means of a four-quadrant detector the form of the beam is detected. Each quadrant is a photodiode which converts the light into a signal current. The form is detected by subtracting the currents of the quadrants from each other in pairs. The resultant focus error signal is used as input of the focus servo. The amplification and the frequency response of the electronics are selected so that the total servo system, electronics and mechanics, is focussed optimally and is not inclined to oscillation.

- Radial Servo
  The radial servo sees to the tracking. It may work according to two principles. Either principle has its own specific optics and electronics. Below follows a brief explanation of both principles.

- Push-pull tracking with wobble
- Three spot tracking

Push-pull tracking with wobble

This is the tracking method which is used in the majority of Philips CD-Audio players. Here the track is so to speak shown reproduced on the detector. The sides of the tracks which mirror strongly are bright and the centre of the track is depicted dark. The use of lenses results in a picture as shown in figure 22.



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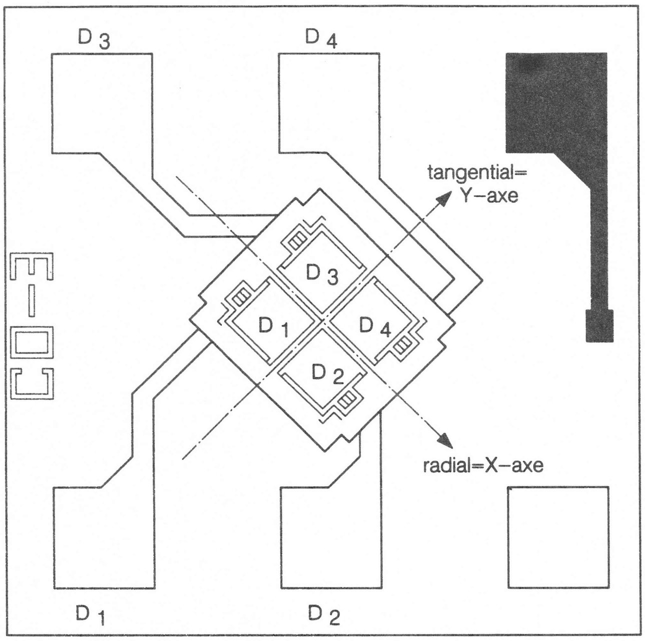
T28/908

Fig. 22

If the detector quadrants are positioned so that quadrants 3 and 4 receive the light from the left-hand side of the track and quadrants 1 and 2 the light from the right-hand side, a tracking error signal can be made. This is done by subtracting the quantity of light on the two right-hand detector faces from the quantity of light on the left-hand two. When the scanning beam is exactly on the track, the radial error (RE) signal is zero both halves are exposed equally. Too much right-hand tracking results in a negative error signal which drives the arm to the left. A detector PCB for Push-Pull tracking is drawn in figure 23.

DIODE PCB ASSY for single beam
tracking and astigmatic focussing.



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T28/908

Fig. 23

As extra this system makes use of a guiding signal which is injected in the radial servo loop. This wobbel signal makes the arm swing from the left to the right within 10% of the width of the track.
This wobbel results in an AC error signal with the same frequency as the injected signal. Detection of the phase margin of the remeasured injection signal is used to control the amplification of the Radial Error signal. The amplification and the frequency response are such that the control is optimal and is not inclined to oscillate. The wobbel signal is also used to enable compensation of optimal deviations. An optical error is formed when the laser beam is e.g. not equally rich in energy across its length. As a result the arm would start tracking on the edge of the track instead of in the centre. This error is eliminated via the compensation. With the wobbel signal the right amplification and the right amount of compensation are made.

- Three beam tracking.

This is a tracking method used by many CD-Audio players and most CD-Video players.
The optics are slightly more complicated but the electronics are simpler. The three scanning beams drawn in figure 24 are made of one beam. These sets have thus only one laser. This is done by sending the chief ray through a grating. The result are two satellite spots. These two satellite spots, E and F, are used for tracking. See figure 24.

The main spot is used to read the data from the disc and for focussing. Here too a Radial Error signal is made by subtracting the signals coming from the E and the F spots. The detector looks as shown in figure 25.

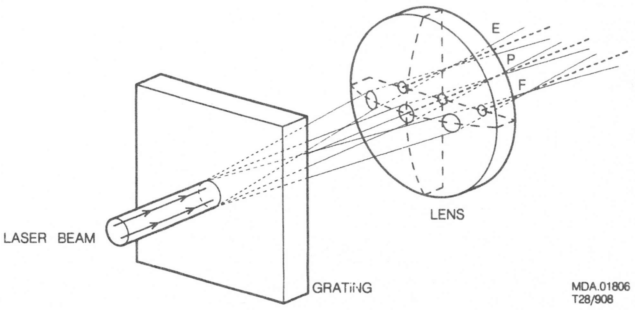

Fig. 24

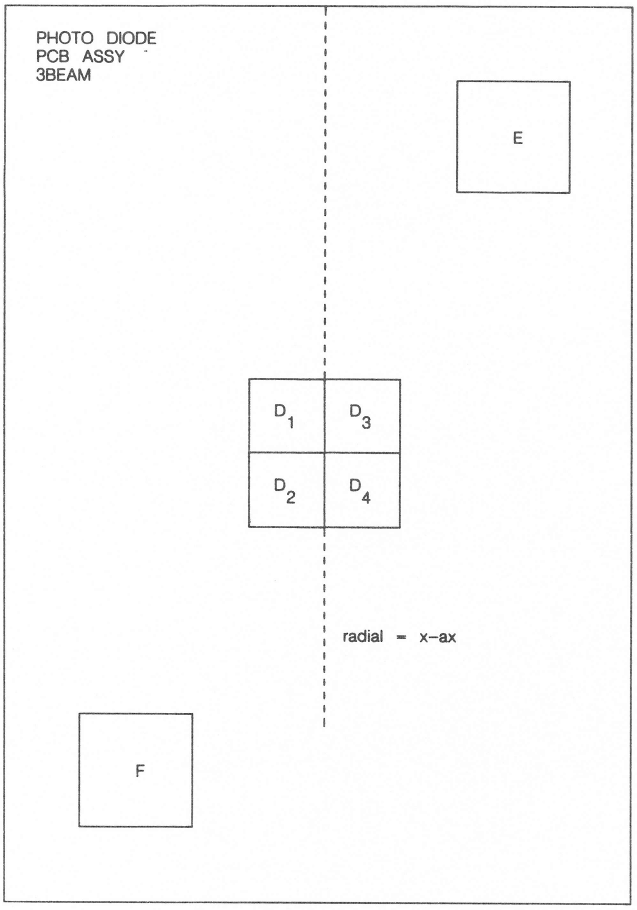

Fig. 25

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3 BEAM TRACK FOLLOWING PRINCIPLE

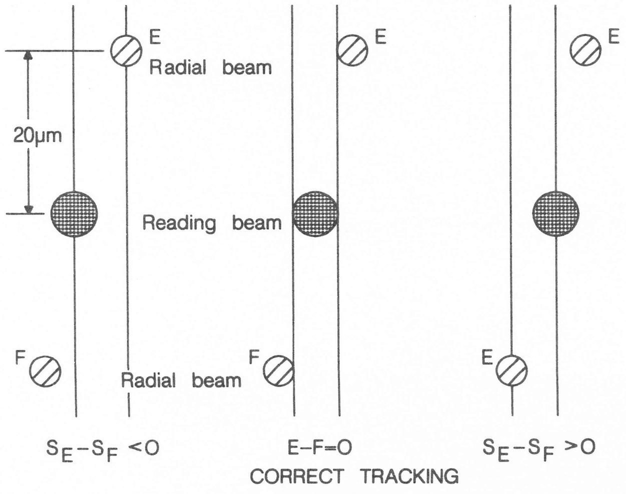

Fig. 26

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The principle of the three beam tracking is given in figure 26.

Note that the angle between E,P,F and the track is important.
For both systems, Push–Pull and Three beam, the RE signal is used to drive a two–stage servo. The first stage drives the little arm for the fast tracking and the second stage drives the spindle to shift the Optical Pick–up unit so that the arm gets sufficient elbow room. Due to the eccentricity of the disc the little arm will always make a sinusoidal movement. However, due to the spiral–shape of the track the zero line will slowly but surely shift.
When the Optical Pick–up unit is shifted in the correct position the zero line will again be in the centre. This is shown in figure 27.

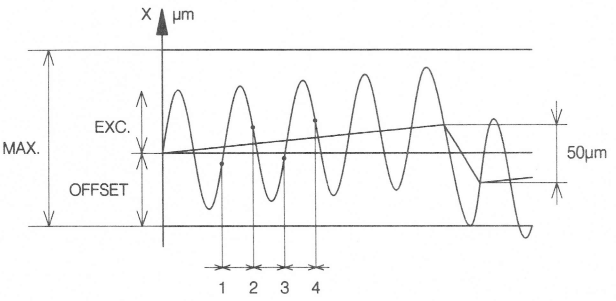

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Fig. 27

Every half revolution of the spindle gives a shift of 50 µm in the case of the CDM 6. The detection of the deflection of the little arm can be done in several manners.
The DC current through the coil which drives the arm can be measured to see if the deflection threatens to become too great (CDM 7, CDM 10). It is also possible to let an additional optical detector measure the displacement of the arm to see if readjustment is required. Both systems displacement are applied. For the CDM 6 the optical detector for measurement of the arm movement is called the X–detector. It has been drawn in figure 16.

9 RF video – EFM split

An important part in the main signal path of a CDV player is the split of the Video and the Audio data. This is done in a simple manner by means of filtering.
During modulation of audio and video on the disc a special method is used. As we have mentioned before in block I, space in the frequency spectrum coming from the disc is reserved for video data. Figure 28 shows the spectrum of the RF signal coming from the CDV disc. The CVBS signal is FM modulated on a carrier of 7.6 MHz in the PAL system. This is done via socalled pulse position modulation. The relatively low frequency EFM signal with the digital audio data is modulated on this pattern by pulse width modulation. See figure 29.

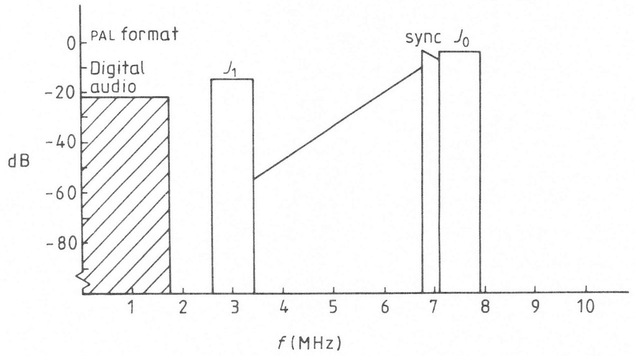

Fig. 28

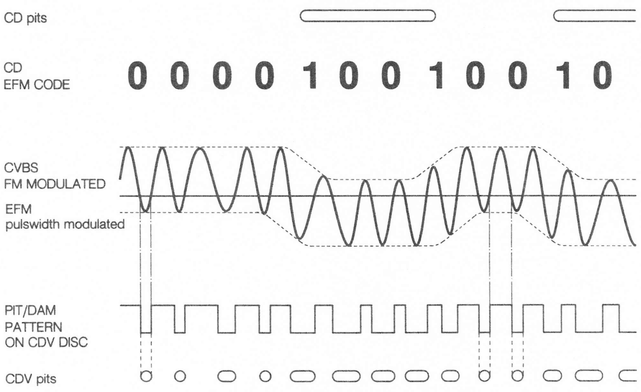

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Fig. 29

10 MTF correction

The Modulation Transfer Function correction relates to the response of the diode laser system. The digital audio (CD) eight to fourteen modulation (EFM) system produces a frequency spectrum with a highest frequency of about 1.8 MHz. Due to the transfer function of the laser diode system the signal recovered from CD only discs has a slope of 3dB rising at the lower frequencies. The digital audio signal (EFM) from CDV discs is at a much lower level than the one recovered from CD only discs. However, it is less affected by MTF due to the higher scanning rate of the disc and, consequently, by larger pits and spaces. Therefore, after selection of the EFM via a low-pass filter the signal path is normally switch selected by a CD mode line. In the CD mode slope correction takes place. In the CDV mode an extra gain must be accomplished.

Another effect of MTF is produced when constant angular velocity (CAV) discs are played. One rotation of a CAV disc always provides one picture (two frames). This means the pit density is much less at the outer diameter of the disc than in the centre, resulting in an increase in recovered bandwidth towards the outside of the disc. Therefore, a correction for the video bandwidth must take place before the demodulation.

11 The tangential tracking

From the CTV technique it is known that either the line duration or the timebase must be exactly 64 µs for a good line reproduction. Furthermore, the frequency of the colour carrier must be exactly 4.43361875 MHz to come to a good colour demodulation. This need not cause problems with a good speed control. However, when the hole is not exactly in the centre of the disc, the track sweeps relative to the Optical Pick-up unit. This sweep causes both a radial and a tangential error. The radial error is compensated by the radial servo. The tangential error which is in fact an acceleration and deceleration of the pit/mesa current, is expressed in too short or too long timebases and hence colour disturbances.

The tangential error is expressed in the timebase of the signal. The correcting circuits are thus called by the collective name TBC, timebase correction. The error in the timebase is measured in these circuits and then corrected. This is done in several steps.

Usually the following three steps can be distinguished:

- *Speed control:*
  It serves to render the timebase of the disc equal to the reference timebase. The control used is a frequency/phase control.
- *TBC coarse control:*
  It serves to reduce the error in the line duration to less than approx 0.2 µs. This is a coarse compensation of the remaining timebase error.
- *TBC fine control:*
  The TBC fine control is also called the colour timebase correction, because this control minimizes the colour error. This correction should reduce the error to less than 10 ns. The sync coming from the disc is insufficiently sharp in edge for such fine corrections. That is why a special burst signal is mastered on a CDV disc in the sync, which is used for this correction. See block IV.

The speed control is a servo control which runs via the turntable motor. The TBC coarse and fine control usually proceeds via a FIFO (First In First Out) buffer. This is an intermediate memory with a variable lead time. The data from the disc is delayed in the intermediate memory so that the data leaves it at the correct speed.

In principle this delay can take place at two points in the signal current.

These two points are:

- The FM modulated signal (the pulse spot signal) passes through the FIFO buffer.
- The FM demodulated signal (CVBS) is sampled and passes through a FIFO buffer.

The second method will be explained in more detail. In principle both methods are the same. In the CDV 475 the second method has been used but with the coarse and fine control switched in series and with feedback per control stage.

BLOCK IV The TBC control

The timebase correction can take place in different manners. In the preceding text we have already mentioned the TBC coarse and fine control. In modern players these controls are combined. The control element and the error measurement circuit then are the same for coarse and fine control. See figure 30. The error measurement is the same for both stages and works on the basis of the special burst.

During this measurement the reference (15625 Hz) is compared with a certain zero crossing of the special burst. Because of the slope of the edges in the special burst which has a frequency of 3.75 MHz the time error can be measured very accurately and be forward corrected. Since the phase of the colour burst changes from line to line it cannot be used for time measurements. The control works with a forward branch and a feedback loop. The forward branch has a large bandwidth and amplification. Since this branch has no feedback, there is no oscillation. The remaining minor time error is eliminated by the feedback loop.

On an average the length of a line duration coming from the disc is correct. The turntable motor servo sees to it. However, sweeps of the disc will cause accelerations and decelerations in the pit/mesa current and, consequently, some lines will have too great a timebase and other ones too small a timebase. Extension comes down to deceleration and shortening to acceleration of the data flow. On an average the data is delayed half a line duration and next passed on. If the data is delayed less than half a line duration, it seems as if the data is accelerated. Also see figure 31.

The line data contents drawn in figure 31 has been selected at random per line to clearly show the effect of the delay. The first part illustrates how on the basis of the correct line duration (length) first the data flow is slightly accelerated and then decelerated. The second part illustrates the course of the process in the case of first a delay and then an acceleration. On an average the time error across one revolution is zero. In modern videodisc players the data is delayed ”accelerated” in a Bucket Brigade. Acceleration is done by filling more buckets at the input per unit of time and to pass them on faster. Deceleration is done by less rapid filling and less rapid passing on of the buckets.

The Bucket Brigade is formed by a CCD chip (Charge Coupled Device).

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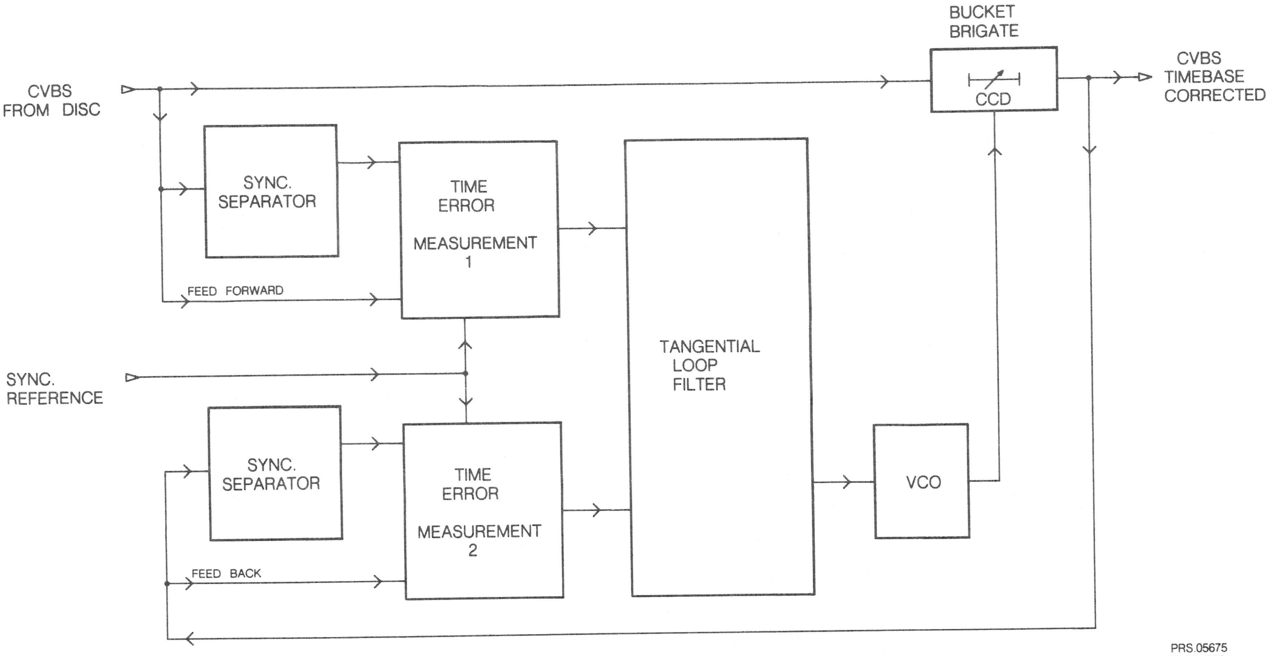

Fig. 30

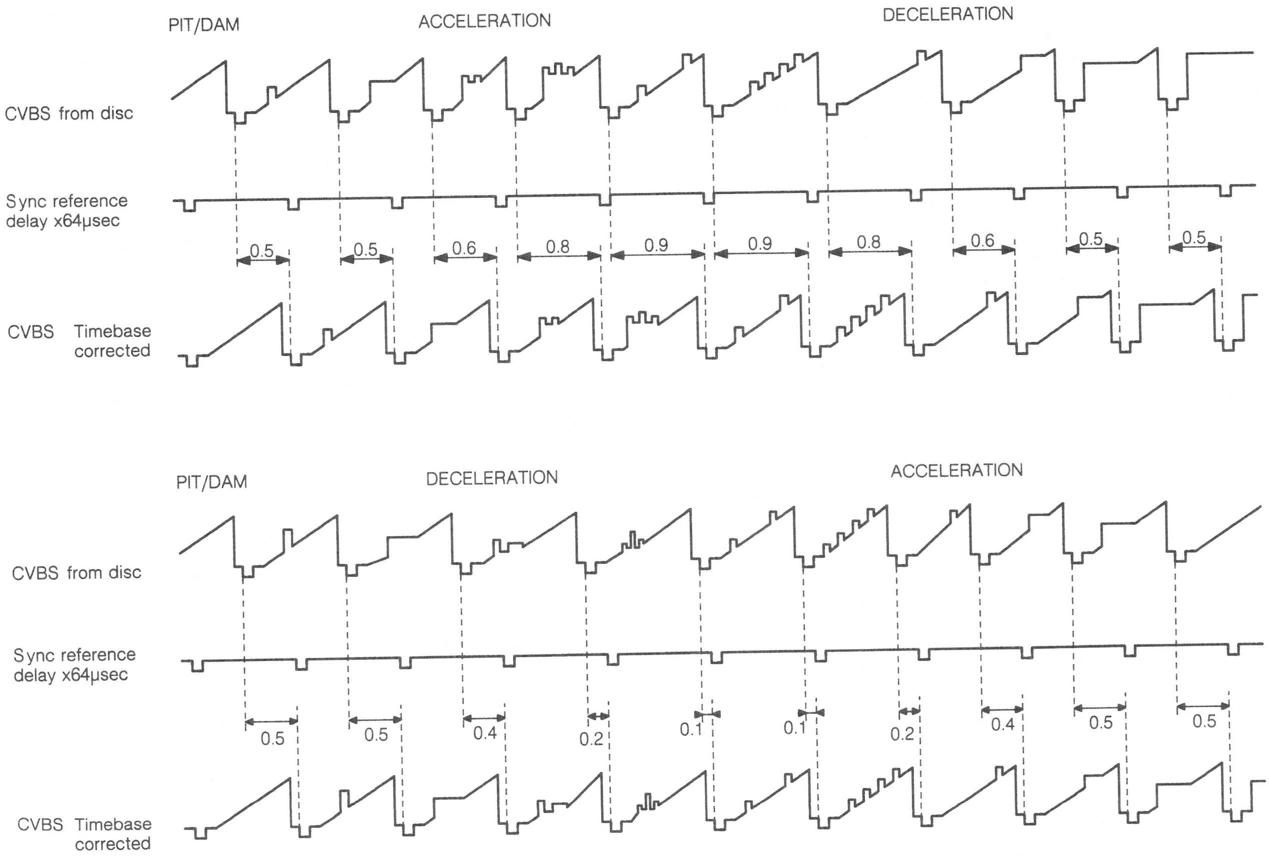

Fig. 31

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12 Speed control

As indicated above, a CDV player must be capable of playing discs at different speeds; figure 32 shows a summary.
When tracks with video data are played, the speed is controlled from the difference between the video sync signal of the disc and the sync reference. During playback of a normal CD track the speed is controlled with a signal derived from the degree of filling of the Digital Audio intermediate memory. This intermediate memory is filled at a speed which is determined by the read-out speed of the optical pick-up. The intermediate memory is emptied by the system clock. Due to this intermediate buffering there no longer is wow and flutter in the ultimate Digital Audio signal.

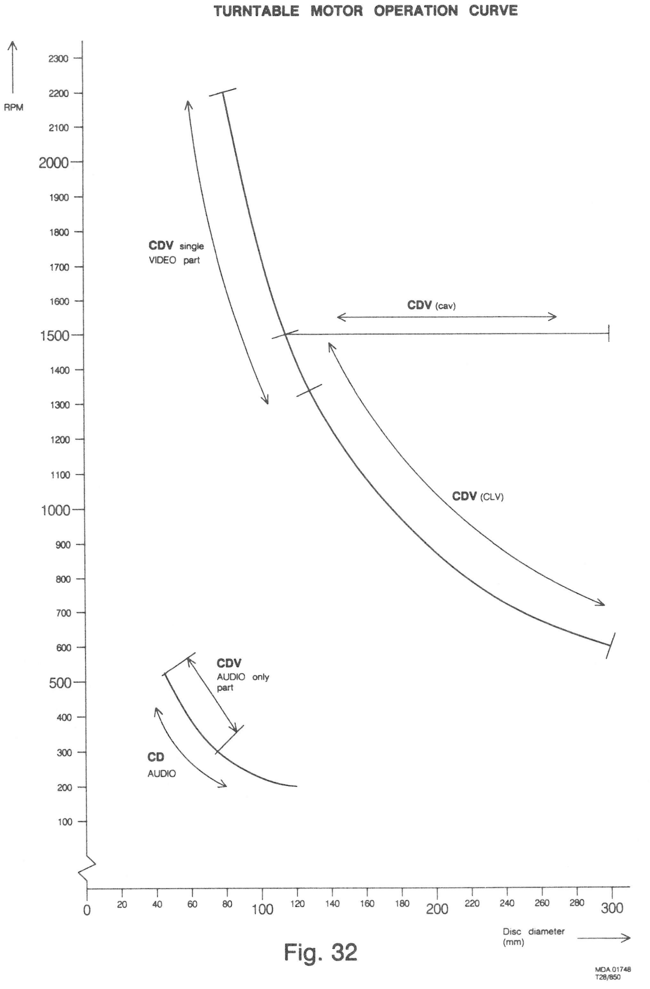

Fig. 32

13 Video line frequency and Digital Audio

Playback of CDV tracks with video and digital audio presents a problem. The speed is controlled by the video data and not via the digital audio. During the mastering of the CDV tracks the digital audio and the video data is recorded coupled to one reference frequency. During playback the line frequency coming form the disc is rendered equal to the internal line reference frequency of the player. This equalization is done by the speed control. The audio sample frequency then coming from the disc is perfect but may still have a very minor deviation due to possible tolerances on the crystal of the system clock. To prevent the audio intermediate memory from slowly getting full or empty, the control signal from the degree of filling of this memory, which normally controls the speed in the case of audio discs, is now used to perform a minor correction on the system clock. See block diagram figure 33.

14 CVBS-RGB-CVBS

In the player the CVBS signal from the disc is converted into an RGB signal. This is done in a CVBS-RGB converter which can process the rapid alternations of the burst phase without looking forward. In the CDV player special play modes are possible. During these special play modes it is desired to have colour on the CTV screen. However, to obtain the correct colours, the burst signal must have the right frequency and the right phase. The frequency is controlled by the tangential loop but the phase of the burst signal must be correct as well. From the CTV theory it is known that the phase of the burst changes 90° every line. Another thing known from the CTV theory is that the (R-Y) signal changes phase every line, a phase of 180°. This must also be continued when the player jumps back to the same track. Moreover, due to the fact that the subcarrier frequency is 4433618.75 Hz, the number of periods of the subcarrier during one picture is (= revolution on a CAV disc) 177344.75. So when the player jumps one track backward or forward, here too a phase error occurs.
In order not to set the demodulator in the CTV the difficult task of using this varying burst for demodulation, the burst phase in the CDV player is corrected. First the CVBS signal from the disc is demodulated with the burst from the disc. The resultant RGB signal is used to insert in screen texts and next it is directly passed on to the RGB out. Sets without RGB in with just CVBS in or RF in cannot directly use the RGB out. For these sets the RGB signal in the CDV player is again converted in CVBS. Starting from the RGB signal burst errors are no longer available in the new CVBS signal and the burst changes phase per line just as with a normally received TV signal. Such a CVBS output is available on all CDV players since sync must also be transferred during the transfer of RGB. The sync signal then goes via the CVBS line. In the TV the CVBS signal is demodulated and the sync is separated. In principle the resultant delay must be caught in the TV. If this is not the case, the picture will move slightly to the left.

15 CVBS drop-out compensation

After the FM demodulation of the RF signal of the disc a CVBS signal remains in the video mode which still requires a timebase correction and a drop-out compensation. Drop-outs are interferences in the RF signal which result in an undesired signal amplitude in the CVBS signal. Usually, this signal amplitude corresponds with a whiter than white signal or a blacker than black signal. The exceeding of these levels is thus the criterion for a drop-out. Drop-outs would cause very bright or very black stripes in the picture. To prevent these interferences the luminance information from the preceding line is filled in instead of the drop-out. The information in the preceding line will not deviate much from the real information. The preceding line is kept in a delay line of 64 µs which can be made via a Bucket Brigade. It is not possible to fill in colour information because the preceding line does not have the correct burst phase.

To make the edges of the drop-outs look good a slightly greater piece of the preceding line is inserted than absolutely required. The result of the drop-out compensation can be called nice. Unfortunately, interferences in the RF signal which do not exceed the drop-out threshold are not noticed but they are visible.

AUDIO BLOCKDIAGRAM

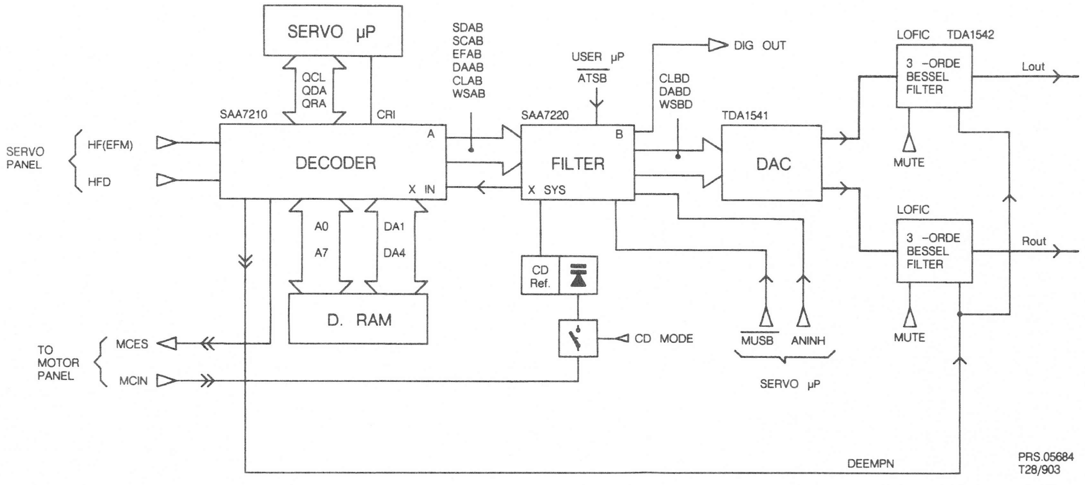

Fig. 33

List of drawings used and a brief description of the drawings.

FIG.	DESCRIPTION	
1	The CDV logo	photo
2	Pit/Mesa pattern on CD	MDA 02066
3	The CD spectrum	photo
4	The discs from small to large	photo
5	Compact disc dimensions	MDA 01802
6	List with CDV 475 features	photo
7	Active play	MDA 01819
8	CAV and CLV	photo
9	Build-up of a CDV player	PRS 05676
10	Active tilt control	MDA 00379
11	Scanning details	MDA 01807
12	The block diagram of the CDV 475	PRS 03212
13	CDM 6 exploded view	EVA 00775
14	CDM 6 photo	photo
15	CDM 6 photo optical pick-up unit	photo
16	CDM 6 opu exploded view	EVA 00776
17	Tray and discs photo	photo
18	CDM 10 exploded view	EVA 00816
19	CDM 10 photo	
20	Astigmatism	MDA 00687
21	Focus error signals	MDA 01749
22	Radial error signals	MDA 2040
23	Detector PCB single beam	MDA 01032
24	The Grating and the E,P,F spot	MDA 01806
25	Detector PCB three beam	PRS 05659
26	Three beam tracking	MDA 01801
27	Eccentricity and the spindle coil	MDA 01006
28	The CDV spectrum	photo
29	Pit/Mesa pattern on the CDV	MDA 01818
30	The TBC control	PRS 05675
31	Line-duration control	MDA 02038
32	Speeds	MDA 01748
33	Audio block diagram	MDA 05684